



TIR Comparison Study

Field Test Vs. On-Site Testing

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GMTG Field Test

Questions

- Does on-site testing simulate customer usage?
- Are there any inconsistencies between field failures and on-site failures?
- Is on-site mileage indicative of actual field mileage?
- What can be done to improve the correlation between on-site and field testing?

Vehicles Involved in Study

- 1997-1998 model year C/K and S/T pickups and utilities

Areas of Study

- By UPC:
 - UPC 3: Front axle and suspension
 - UPC 4: Rear axle and suspension
 - UPC 5: Brake system
 - UPC 6: Engine
 - UPC 7: Transmission
 - UPC 8: Fuel and exhaust systems
 - UPC 9: Steering system
 - UPC 10: Wheels and tires
 - UPC 12: Electrical, instrumentation, convenience items

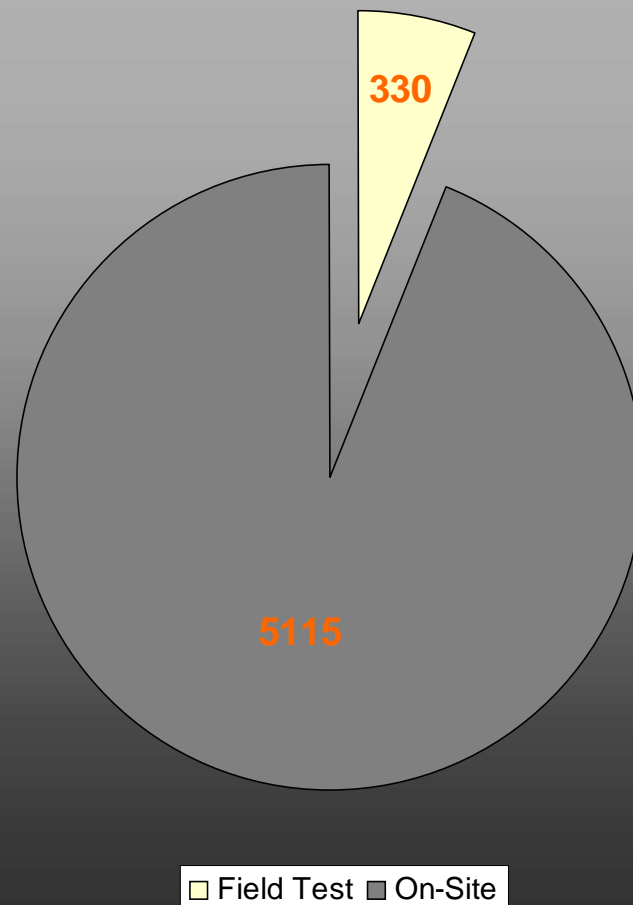
Areas Not Covered in Study

- By UPC:
 - UPC 1: Body
 - UPC 2: Frame
 - UPC 11: Exterior components forward of dash

Beginning the Study

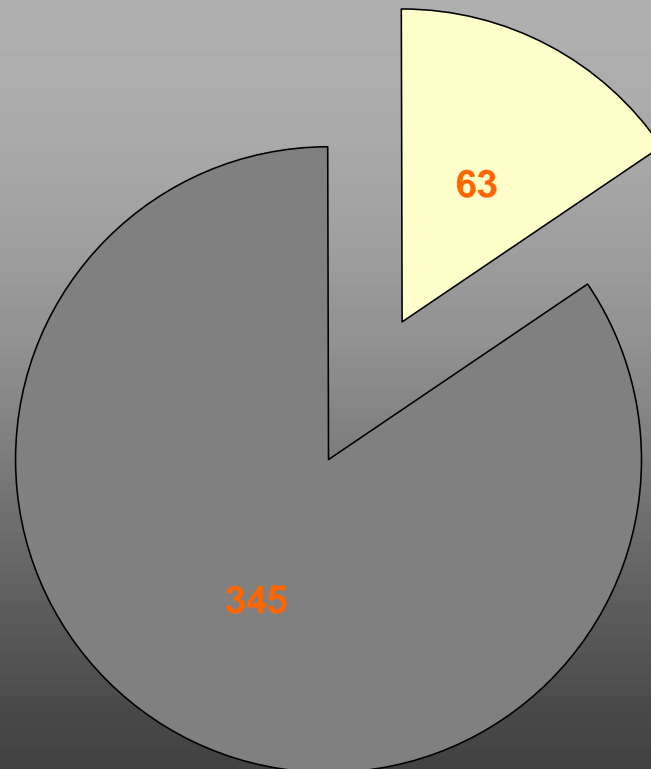
- TIMS access provided by Dave Howard and Kay Davis
- Queried TIRs by UPC using QMS
- Observed common modes of failure in field test TIRs and samples of corresponding on-site TIRs

Number of TIRs



UPC 3 TIRs

Front axle and suspension



Field Test On-Site

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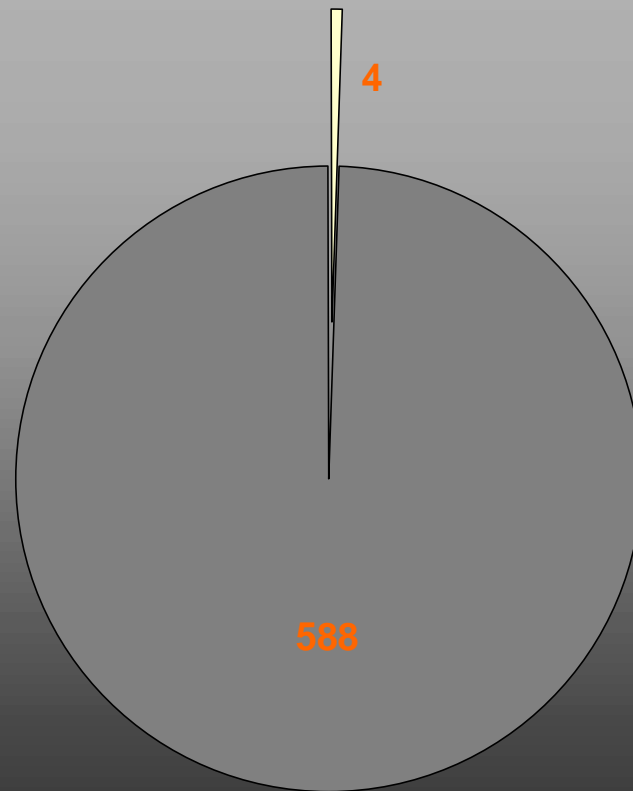
Field Test UPC 3

Front axle and suspension

- 4WD problem area
- Suspension relatively free from incidents
- Common problems:
 - lube leak
 - differential and differential carrier
 - front axle non-engagement
- Dirt intrusion a primary cause

UPC 4 TIRs

Rear axle and suspension



Field Test On-Site

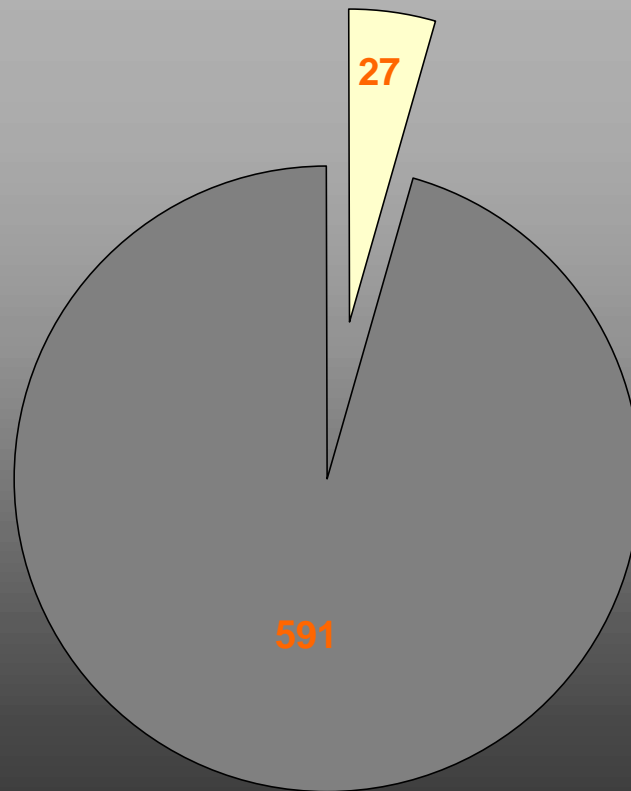
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Field Test UPC 4

Rear axle and suspension

- Low problem area for field test vehicles
 - lube leak
 - propeller shaft U-joint
- Dirt intrusion blamed for lube leaks
- Not statistically valid?

UPC 5 TIRs Brake System



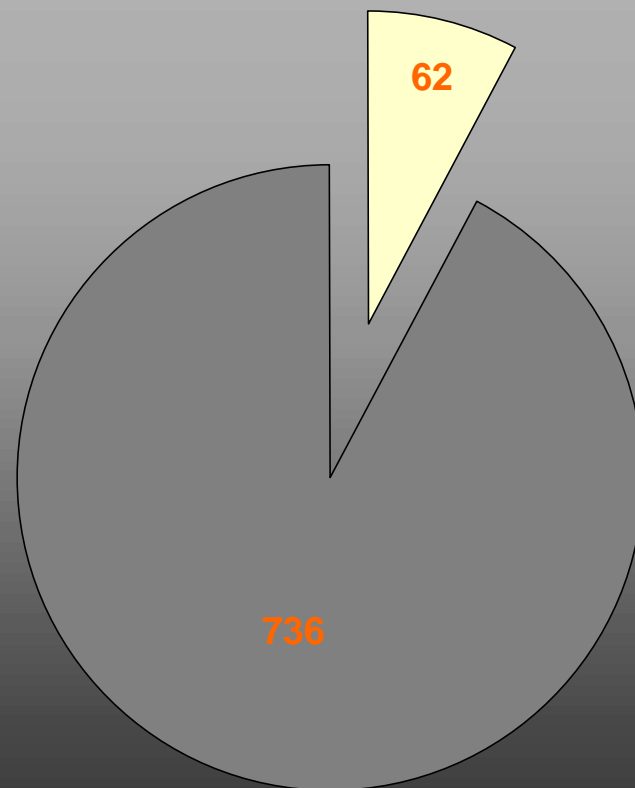
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Field Test UPC 5 Brake System

- No particular pattern
 - Typically Class 4 and higher
- Common wear, corrosion
- Some trouble with ABS diagnostics
- No problems with brake booster or lines

UPC 6 TIRs Engine



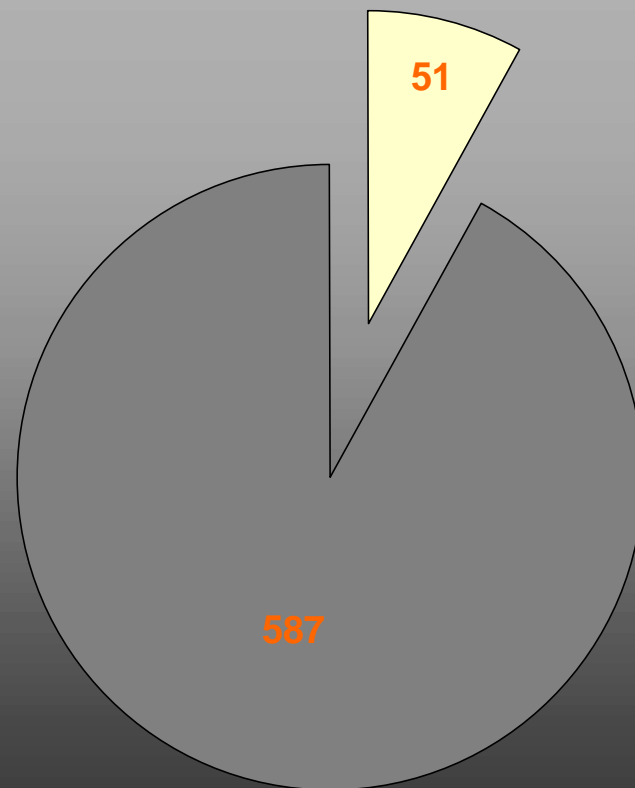
Field Test On-Site

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Field Test UPC 6 Engine

- Frequent problems with:
 - cooling system
 - EGR
- Recommend more hot weather testing
- Some problems with:
 - carbon sensitivity of air filter change interval indicator
 - crankshaft position sensor

UPC 7 TIRs Transmission



Field Test On-Site

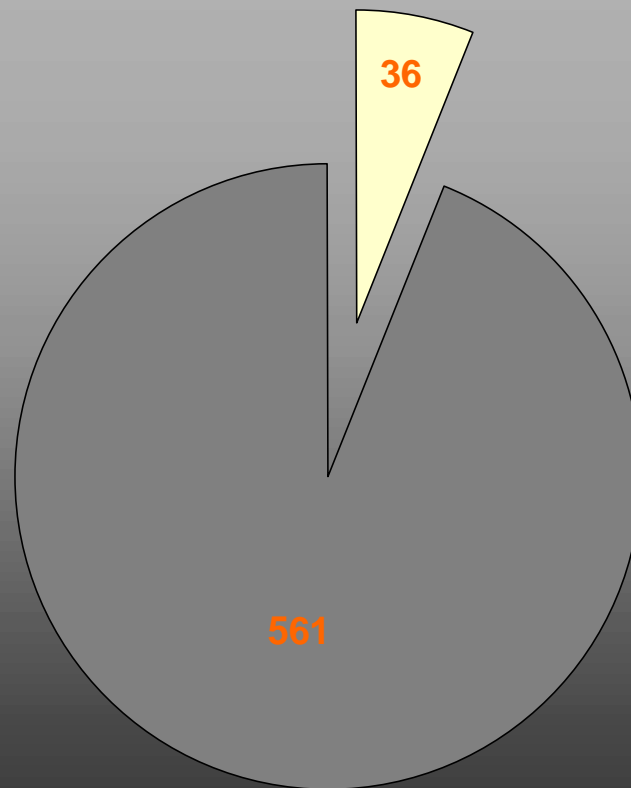
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Field Test UPC 7 Transmission

- Frequent problems with active transfer case:
 - slipping, harsh engagement, front axle non-engagement
- Multiple root causes including:
 - pre-production TC software versions
 - improper maintenance practices

UPC 8 TIRs

Fuel and Exhaust Systems



Field Test On-Site

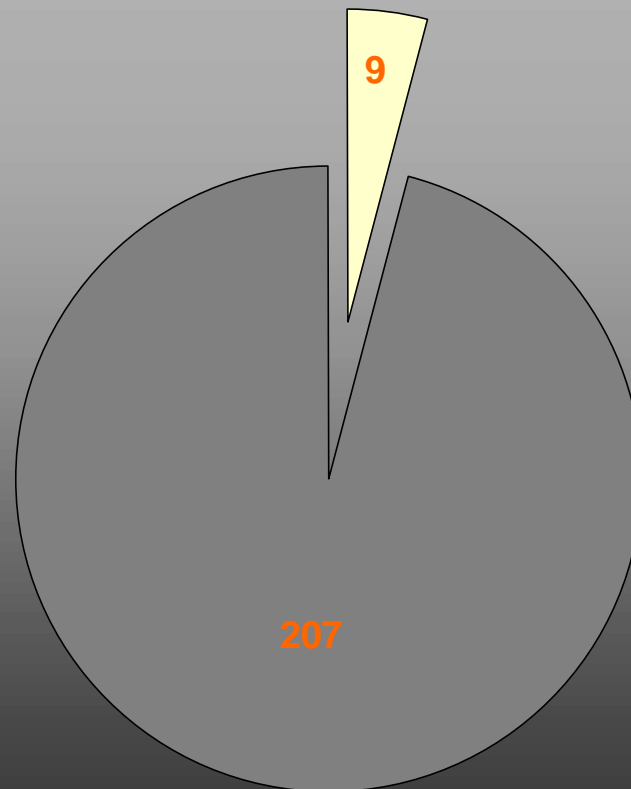
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Field Test UPC 8

Fuel and Exhaust Systems

- Relatively low problem area
- Some fuel pump problems

UPC 9 TIRs Steering System



Field Test On-Site

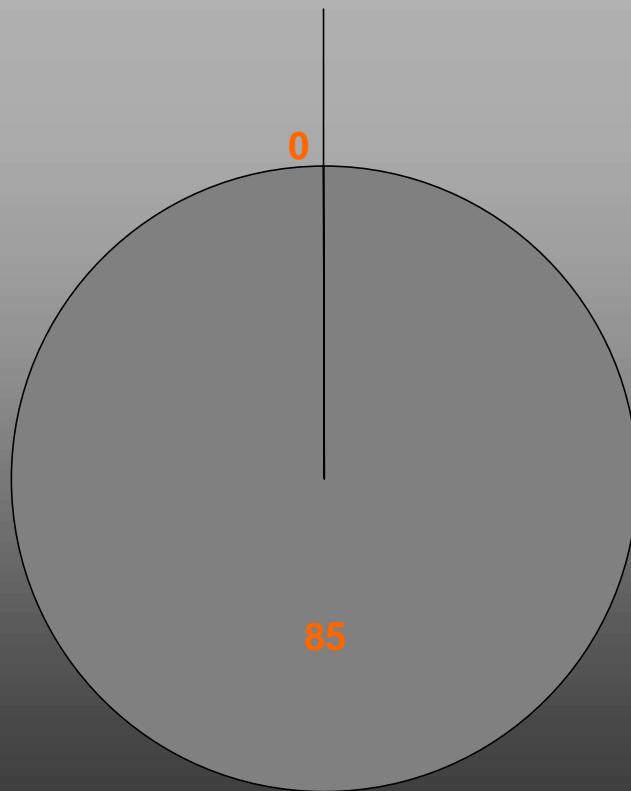
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Field Test UPC 9 Steering System

- Very low problem area
- Some leaks from steering pump
- Horn stays on!

UPC 10 TIRs

Wheels and Tires



Field Test On-Site

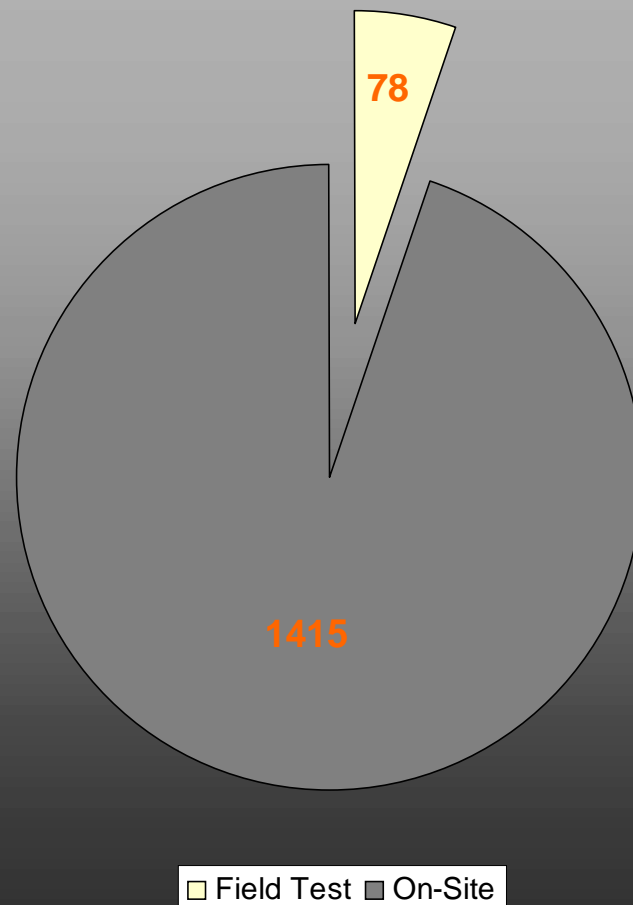
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Field Test UPC 10 Wheels and Tires

- Extremely low problem area
- No Field Test TIRs

UPC 12 TIRs

Electrical, Instrumentation, Convenience Items



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Field Test UPC 12

Electrical, Instrumentation, Convenience Items

- Some problems with:
 - VCM, diagnostics
- ABS/Wiper (Class II Communication) interference
- Many improper installations and handling practices
- Software bugs
- Theft deterrent module/Passlock software

Field Test Problem Parts Defined

- Parts with more than 3 documented Field Test TIRs
- Field Test's "27 Problem Parts"
 - none in UPC 4, UPC 5, UPC 9 and UPC 10
- Are these also the problem parts for on-site testing?

Field Test's Problem Parts

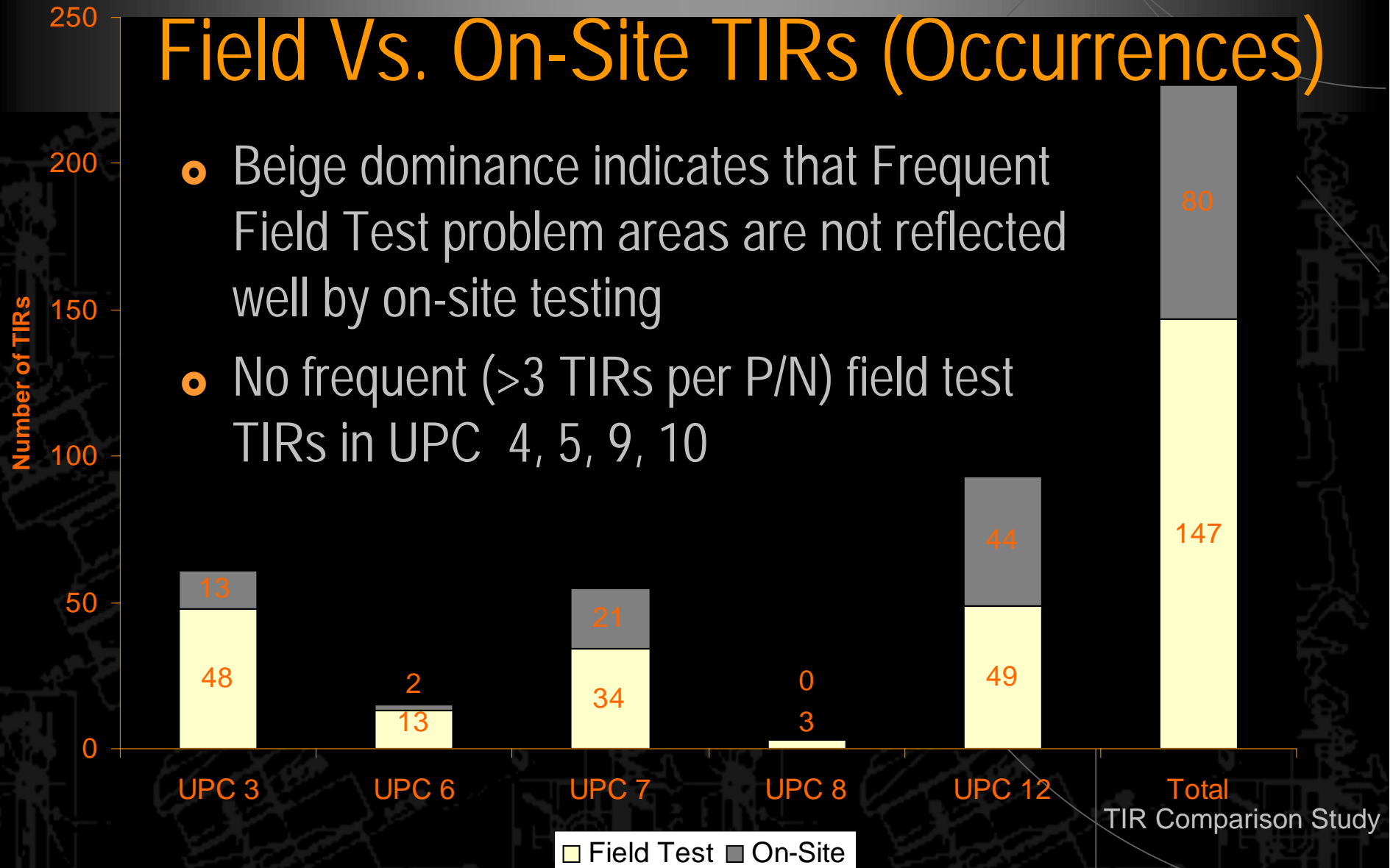
UPC	P/N	Failing Part Description	# Field Test Incidents	# Other Incidents	Avg. Field Test Part Miles	Avg. On-Site Part Miles	Incident Trouble	Causes
3A	TX121162	Front differential	5	3	20959	14467	Leaks lube	Excessive play due to cold weather
3A	TX126083	Front wheel drive shaft	6	0	15232	-	Noisy, failure	Mud buildup, improper installation
3A	10456200	Crankshaft position sensor	4	1	10000	0	Leaks oil	Bad installation & design
3A	26046029	Front differential	6	1	16970	16295	Front axle non-engagement, leaks lube	Improper installation, design errors
3A	26046030	Front differential	12	0	22519	-	Front axle non-engagement, leaks lube	Variety (weather, excessive use, bushings)
3A	26055995	Propeller shaft	3	5	51013	13635	Worn, leaks, noisy	Tire thrown contaminants
3A	26056580	Front wheel driveshaft	6	0	15486	-	Leaks lube	Unspecified
3A	26060073	Front drive axle actuator	6	3	9932	9305	Front axle non-engagement, broken parts	Severe weather, improper installation
Totals:			48	13				
Averages:					20264	10740		
6K	15982137	Engine cooling fitting	3	0	40192	-	Leaks coolant	Brittle tees
6L	17096188	EGR valve	4	0	62653	-	Diagnostic code	Valve pintle coking
6L	17096309	EGR valve	3	2	76667	23621	Diagnostic code	Valve pintle coking
6Y	25168651	Glow plug package	3	0	36697	-	Inoperative	Glow plug design problem
Totals:			13	2				
Averages:					54052	23621		
7E	12547658	Transfer case actuator			27871	11797	Front axle non-engagement	Variety (design, environmental, etc.)
7E	15007094	Transfer case actuator	3	0	9640	-	Inoperative	Foreign particles intrusion
7E	15717188	Transfer case	9	3	41211	6282	Inoperative, leaks	Variety (water, improper operation, broken tab)
7E	15721474	Transfer case shift module	5	1	43731	2606	Diagnostic code	Radio wave interference
7E	15726252	Transfer case adapter	3	0			Leaks	Porosity
7E	15996827	Transfer case	11	14	21347	18305	Leaks, cracks, improper or non-operation	Contaminants, improper design/installation (prototype)
Totals:			34	21				
Averages:					25465	9748		
8C	15722089	Exhaust muffler assembly	3	0	34912	-	Noisy	Unspecified
Totals:			3	0				
Averages:					34912	-		
12F	16213175	VCM	7	0	24024	-	Diagnostic code	Wiper transient interference
12F	16213195	VCM	2	2	10779	0	Erratic operation	Excessive resistance, electronics
12F	16214835	VCM	4	1	21175	26468	Variety (including no run, A/C problems)	Variety (including miswiring of VCM)
12F	16214855	VCM	3	4	16546	10688	Variety (including no run, A/C problems)	Variety (including miswiring of VCM)
12F	25163079	Heated oxygen sensor	3	19	3967	11181	Diagnostic code, loss of performance	Contaminants, sensor internal failure
12L	15732805	Remote lock transmitter	6	0	28039	-	Inoperative	Weak solder joints
12L	16202805	Theft deterrent module	11	13	5744	8294	Diagnostic code	Passlock software error, interference
12L	16215915	Theft deterrent module	13	5	6029	7657	Diagnostic code	Passlock software error
Totals:			49	44				
Averages:					14538	10715		
Grand Totals:			245	116				
Cumulative Averages:					25271	10624		

- For P/Ns with more than 3 Field Test TIRs, on-site testing records very few TIRs
- On-site testing has significantly lower average mileage

TIR Comparison Study

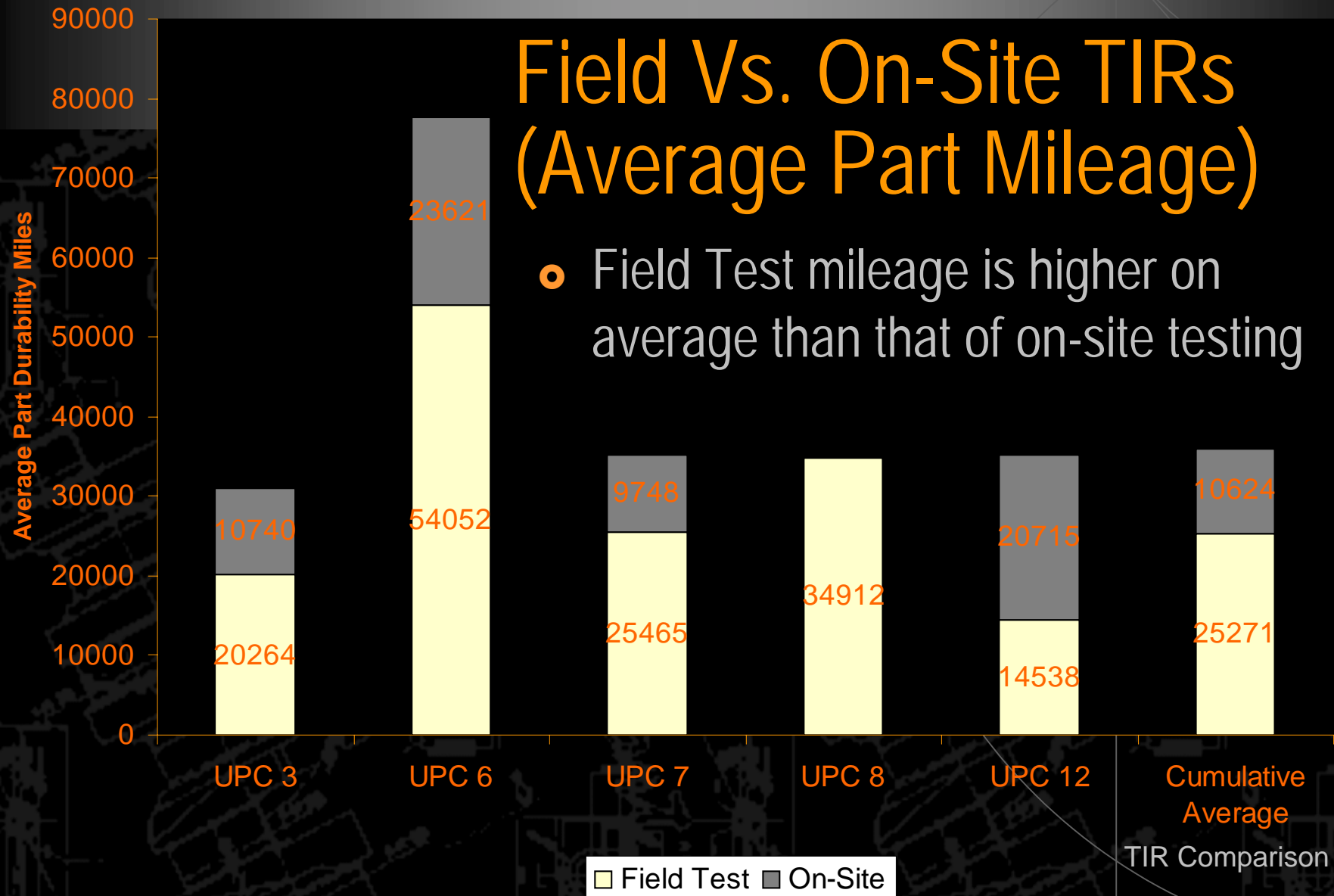
Field Vs. On-Site TIRs (Occurrences)

- Beige dominance indicates that Frequent Field Test problem areas are not reflected well by on-site testing
- No frequent (>3 TIRs per P/N) field test TIRs in UPC 4, 5, 9, 10



Field Vs. On-Site TIRs (Average Part Mileage)

- Field Test mileage is higher on average than that of on-site testing



Field Vs. On-Site TIRs (Summary)

- In Field Test problem areas (>3 TIRs per P/N), Field Test failures are more frequent but occur at lower mileage
- On-site testing is probably accelerated, but do not replicate the root causes of the problems seen by Field Test

Root Causes of Field Test Problem Parts

- Significant number of problems due to environmentally related conditions:
 - cold, hot
 - dirt and foreign particles intrusion
- Some due to poor installation and maintenance practices

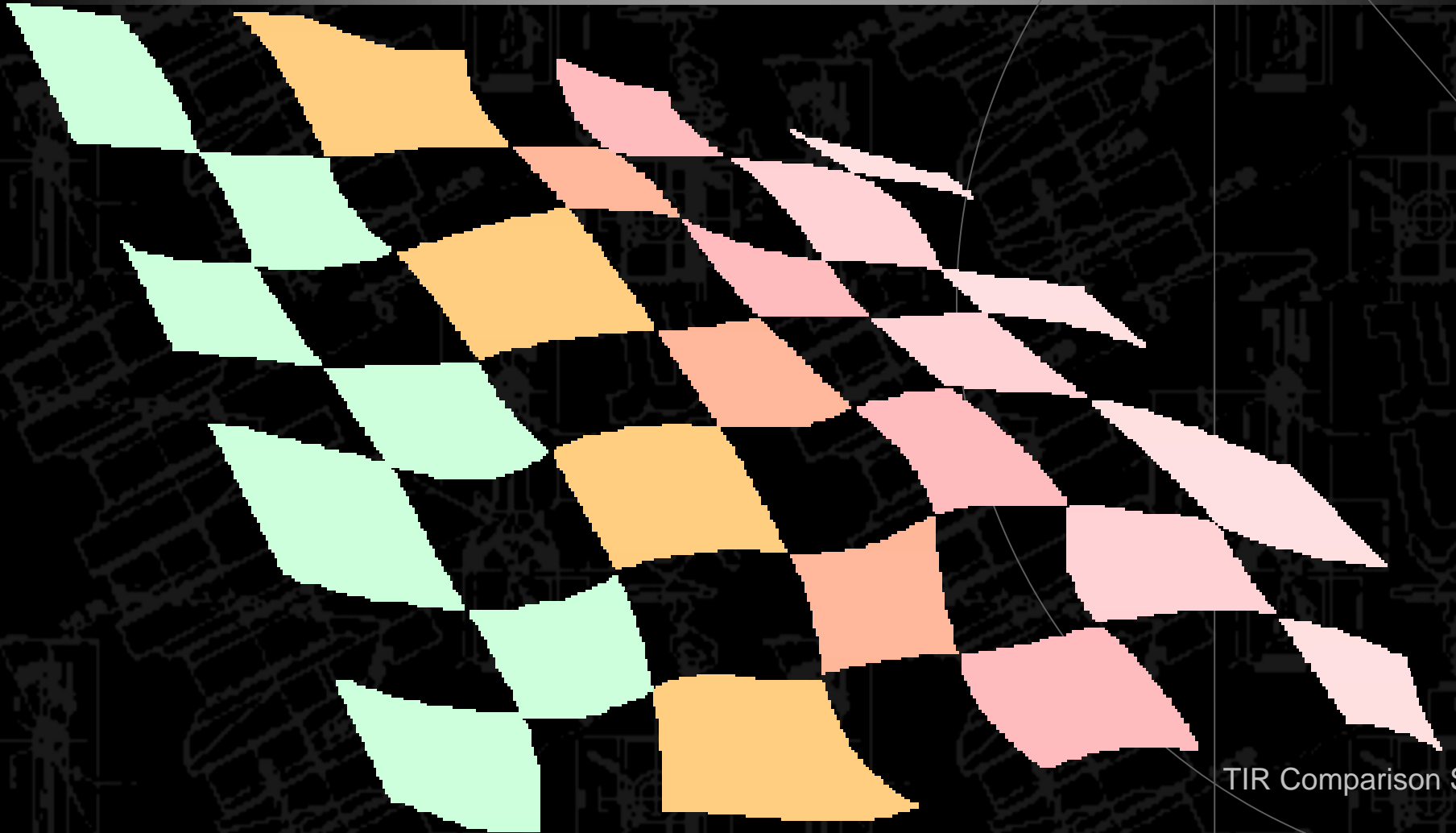
Other Observations

- Very few Field Test TIRs with excessive load cited as root cause
- Several TIRs dismissed due to extreme conditions at mine sites, etc.

Recommendations

- On-site testing should simulate greater temperature and weather extremes
- Rougher environmental schedule for trucks (HVTA?)
- Provide clearer maintenance instructions and parts with greater installation tolerances.

Questions & Answers



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